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A new freshwater catfish (Pisces: Ariidae) from northern Australia

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Abstract

A new species of fork-tailed catfish is described on the basis of 31 specimens collected in northern Australia between the Fitzroy River (Western Australia) and the Mitchell River (Queensland). *Arius midgleyi* sp. nov. grows to at least 1.3 m TL and is distinguished from other Australo-Papuan ariids by a combination of characters including snout shape, barbel length, eye size, tooth arrangement and gill raker number and position. Comparison is made with other ariid species occurring in northern Australian rivers, including the morphologically similar *A. leptaspis* (Bleeker).

Introduction

The Timor Sea and Gulf of Carpentaria drainage systems (Lake 1971) approximately represent the Leichhardtian zoogeographic region of Whitley (1947). The rainfall pattern in this region is dominated by the wet monsoon (occurring within the period November to April). Most rivers here traverse a flat coastal plain about 15 km wide before reaching the sea (Lake 1971). These rivers commonly possess wide flood plains and low gradients, often contracting to a chain of waterholes during the dry season; some (Gregory River; Fitzroy to Daly Rivers) have reaches of rapids or very deep gorges. The average annual discharge from this region is 69 000 billion litres (Lake 1971), most of it occurring during the wet season.

Five of Australia's 18 species of fork-tailed catfishes (Ariidae) are common in this northern region, yet were overlooked by Whitley (1947) and Iredale and Whitley (1938). The members of this family, which is distributed circumglobally in the tropics and subtropics, may inhabit the sea, rivers within tidal influence, or fresh waters. Three ariid species present in these northern rivers (*Cinetodus froggatti* [Ramsay and Ogilby, 1886], *Arius graeffei* Kner and Steindachner, 1886, *A. leptaspis* [Bleeker, 1862]) occur in fresh and adjacent coastal waters and comparative habitats in Papua. Like the relatively small *A. berneyi* Whitley, 1941, which only rarely penetrates brackish waters, *A. midgleyi* sp. nov. is also a freshwater fish. Although exploited commercially since 1978, the distinct taxonomic status of this species has been recognised only recently. The purpose of this paper is to describe this fish, to compare it with the other freshwater fork-tailed catfishes of northern Australia, and to present information on its biology.

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Materials and methods

Counts and measurements follow Hubbs and Lagler (1958) with the addition of: premaxillary tooth band length and width; 'interdorsal' fin space; occipital process breadth and length; maxillary barbel length; free vertebral count (for explanation, see Kailola 1983). Counts of fin elements and gill rakers were made using a needle probe; measurements were made with pointed calipers to the nearest 0.1 mm and, for very large specimens, the length was obtained using a mm-graduated ruler. Vertebral counts (number posterior to the anterior fused complex of 6 or 7 vertebrae, and including the hypural) were made from cleared and stained specimens and radiographs.

The range of counts and proportional measurements for the paratypes of the new species are indicated in parentheses following the data for the holotype, if different.

In order to ascertain which factors contributed most to an explanation of the total variability, all variables were initially evaluated for specimens of both *A. leptaspis* and the presumed new species using principal component analysis (BMDP software package, subprogramme 4R; Dixon 1985). A reduced character set including only the statistically significant variables, was used with cluster analysis (BMDP, subprogramme KM; Dixon 1985) to substantiate the presence of two distinct groups – i.e. *A. leptaspis* and the new species. Interpretation of these results favoured acceptance of a two-groups hypothesis. The resulting population sets (52 specimens of *A. leptaspis* and 28 of *Arius* new species) were then characterised within a stepwise discriminant function analysis (BMDP, 7M; Dixon 1985). Specimens (n=35) of *A. leptaspis* from New Guinea were later entered as 'unknowns' to evaluate the accuracy of this classification function.

The following abbreviations are used in the text and tables: SL – standard length; FL – fork length; TL – total length; HL – head length; D – dorsal fin; A – anal fin; P – pectoral fin; V – ventral (=pelvic) fin; C – caudal fin; GR – gill rakers; l. – length; occip. – occipital; premax. – premaxillary; dist. – distance; interorb. – interorbital; w. – width; caud. – caudal; stn – collecting station.

Material has been deposited in the following institutions: the American Museum of Natural History, New York (AMNH); the Australian Museum, Sydney (AMS); the Northern Territory Museum, Darwin (NTM); the Queensland Museum, Brisbane (QM); the United States National Museum, Washington (USNM); the Western Australian Museum, Perth (WAM); the Zoölogische Museum, University of Amsterdam (ZMA).

Systematics

The new species is referable to the genus *Arius* as proposed by Valenciennes (1840). Taylor's (1986) diagnosis of *Arius* is appropriate for *A. midgleyi* sp. nov. except for the presence of rakers along the rear margin of the first two gill arches.

However, based on examination of the type (*A. arius* Hamilton-Buchanan, 1822) by one of us (PJK) we consider this character is of specific importance only. Because *Arius* contains numerous species, its eventual division into subgenera (based on a global comparison of type material) would seem the appropriate method by which the diversity of its species could be recognised.

The characters which contributed most to an understanding of the variability between the two taxa are: maxillary barbel length as a percentage of standard length, ratio of the length of the dorsal fin spine into head length, total gill raker count on the first arch, head width as a percentage of head length, and snout length as a percentage of head length (and see discussion under 'Remarks'). The resulting discriminant function [$Z_{leptaspis}$ = -366.336 + 12.523 (gill raker count) + 83.390 (dorsal fin spine/HL) + 0.234 ([head width/HL] x 100) + 1.231 ([snout length/HL] x 100) + 0.0152 ([maxillary barbel length/SL] x 100); Z_{Arius} sp. nov. = -369.429 + 9.722 (gill raker count) + 51.859 (dorsal fin spine /HL) + 0.874 (head width/HL x 100) + 1.081 ([snout length/HL] x 100) + 1.145 ([maxillary barbel length/SL] x 100) – where the highest Z score determines membership] separates 100 per cent of the cases accurately in the robust jackknife classification matrix (BMDP, 7M; Dixon 1985). New Guinea specimens of *'A. leptaspis'*, which might be expected to differ somewhat from the Australian stock of this species, were correctly classed into that species group 100 per cent of the time using this classification scheme.

Based on this clear morphological distinction witnessed over many years of sampling for catfish of both sexes from a broad geographic range, we conclude that *A. midgleyi* sp. nov. is reproductively isolated from other Australian ariid species with which it is sympatric (particularly *A. leptaspis* and *A. graeffei*). Therefore, our material meets the criteria for designation as a species (Mayr 1963).

Arius midgleyi sp. nov.

Figures 1-8; Table 1, 2

Arius leptaspis – Taylor, 1964: 81 (in part – see 'Remarks')
Arius species 1 – Allen, 1982: 30.
Arius species 1 – Allen, 1982: 31.

Holotype

AMS I.20858-006, 270 mm SL, Wickham Gorge, Victoria River, Northern Territory, 7 June 1978, collected by D.F. Hoese.

Condition of holotype: Good. Short slit along belly; membrane on all fins split; tip of upper caudal lobe lost.

Paratypes

Western Australia

WAM P.25597-001, (1 specimen), 348 mm SL, Fitzroy River, June 1973, collected by R. Emiliani; WAM P.25708-001, (1), 224 mm SL, Forbes Yard, Traine River, 18 June 1973, collected by J.B. Hutchins; ZMA 119.467, (1), 244 mm SL, near Wyndham in fresh water hole, 12 April 1981, collected by L. Turner; WAM P.28776-001, (1), 166.5 mm SL (cleared and single-stained), Lake Argyle, mid-1980, collected by N. Morrissy; WAM P. 21338-002 (previously included in WAM P.21338-001), (4), 133, 138, 149, 161 mm SL, Ord River, 4 October 1971, collected by R.J. McKay and J. Dell; AMNH 57082, (1), 152 mm SL, Ord River below Duncan Highway crossing, 7 May 1969, collected by J. Nelson, D. Rosen and H. Butler.

Northern Territory

AMNH 57454 (previously included in AMNH 51649), (1), 98.5 mm SL, junction of Big Horse Creek and Victoria River, 8 May 1969, collected by J. Nelson, D. Rosen and H. Butler; AMNH 57454SW (previously included in AMNH 51649), (3), 103, 106 and 114 mm SL, same data as AMNH 57454; NTM S. 11800-001, (1), 325 mm SL, Daly River on Florina Station, 25-26 August 1980, collected by H. and M. Midgley; QM I.16735, (1), 240 mm SL, Hodgson River, 17 September 1979, collected by H. and M. Midgley; QM I.16737, (1), 310 mm SL, Mannaburoo Hole, Limmen Bight River, 1 September 1979, collected by H. and M. Midgley; QM I.16738, (2) (one broken), 327 mm SL and 151.5 mm HL, Mannaburoo Hole, Limmen Bight River, 29-30 August 1979, collected by H. and M. Midgley; NTM S. 12083-001, (1), 331 mm SL, Wilton River, 25-27 September 1979, collected by H. and M. Midgley; NTM S. 12070-001, (2), 298 and 315 mm SL, Mannaburoo Hole, 29-30 August 1979, collected by H. and M. Midgley; NTM/AS F.35, (1), 257 mm SL, Wollogorang Homestead, 15 June 1974, collected by D. Howe; NTM/AS F.36, (1), 273 mm SL, same data.

Queensland

QM I.12910, (1), 326 mm SL, Flinders River near Maxwellton, 14 October 1974, collected by H. and M. Midgley; QM I.12757, (1), 310 mm SL, same data; QM I.16730, (2), 329 and 315 mm SL, Flinders River in Maxwellton area, October 1974, collected by H. and M. Midgley; QM I.11364, (1), 205 mm SL, Forest Home Station, Gilbert River, 24 September 1953, collected by T.C. Marshall; AMS IB.2882, (1), 171 mm SL, same data; QM I.11990, (1), 145.5 mm SL, Mitchell River, 8 September 1959, collector not stated.

Diagnosis

A sleek catfish, attaining a large maximum size (known to 1.3 m). Barbels thin and short, rarely reaching beyond pectoral fin base and less than 25 per cent SL; jaws strong, upturned slightly at symphyses, mouth broad; snout truncate in profile; head oblong, its width averaging 66 per cent HL. Occipital process narrow, with parallel borders. Numerous fine, sharp teeth on palate in transverse band of four oblong groups. No rakers on posterior aspect of gill arches. Gill rakers on first arch few, 10-17; A 16-19. Number of free vertebrae 47-50.

A. midgleyi is distinguished from *A. graeffei* and *A. berneyi* by lacking rakers on the posterior (inner) aspect of the first and second gill arches (present on all arches in these two species). From *Cinetodus froggatti*, it differs in having a much broader mouth, four groups of teeth in a band across the palate (two patches only in *C. froggatti*) and wide gill openings extending well forward from the isthmus (restricted and terminating opposite lower pectoral base in *C. froggatti*). *A. leptaspis* is most similar to *A. midgleyi*. The two species may best be separated on the relative length of the maxillary barbels (Figure 7) (16-25 per cent SL, cf 22-51 per cent SL in *A. leptaspis*). The maxillary barbel rarely reaches as far posteriorly as the head margin in *A. midgleyi*, but reaches and extends beyond the pectoral spine base and further in *A. leptaspis*. Additional characteristics which distinguish these two species are: the combination of head width (56-76 per cent HL, cf 66-83 per cent HL in *A. leptaspis*) (Figures 5, 6, 8), snout shape and the total number of rakers along the face of the first gill arch (10-17, cf 13-22 in *A. leptaspis*) (Table 1). The shape of the occipital process and extent of the granular head shield also differs between the two species, *A. leptaspis* having a broader process and more extensive shield, the dorsomedian head groove terminating a considerable distance before the base of the occipital process. Moreover, *A. leptaspis* is only known to a maximum body size of 60 cm FL (Bishop *et al.* 1986).

Description

The range, mean and standard deviation of meristics and selected proportions are given in Tables 1 and 2.

D I,7. A 18 (16-19). P I,11 (9-11). V 6. C primary rays 7+8. GR (first arch 16 (10-17) of which 6 (3-6) on upper limb. GR (last arch) 18 (11-19). Number of free vertebrae – (47-50; 17 specimens, mean 48.3). Branchiostegals 6.

Table 1 Meristics and relative body proportions of *Arius midgleyi*. (Ratios could not be computed if character is damaged or missing on a specimen.) n=sample size; SD= standard deviation.

Character	Holotype	Paratypes			
		n	range	mean	SD
SL (mm)	270	29	98.5-348	233.7	83.4
HL in SL	3.1	29	3.0- 3.5	3.2	0.1
eye 1. in HL	7.5	30	4.6- 11.4	7.8	2.1
eye 1. in snout 1.	2.7	29	1.6- 4.2	2.8	0.8
eye 1. in bony interorbital width	2.5	28	1.3- 4.1	2.6	0.9
occip. process width in process 1.	2.8	29	1.5- 2.8	2.0	0.3
D. spine 1. in HL	1.5	28	1.4- 2.4	1.8	0.3
P. spine 1. in HL	1.5	26	1.6- 2.4	1.9	0.2
adipose fin base in D. fin base 1.	1.1	28	2.1- 3.7	2.8	0.4
caudal peduncle depth in its 1.	2.2	29	1.7- 2.6	2.1	0.2
predorsal 1. in SL	2.4	29	2.4- 2.7	2.5	0.1
longest barbel in SL	4.6	29	4.1- 6.0	5.1	0.5
head height in head width	1.4	29	1.2- 1.7	1.4	0.2
1. premax. tooth band in its width	9.5	28	5.2- 9.9	7.7	1.3
count of A. fin rays	18	29	16 - 19	17.6	0.9
count of P. fin rays	11	29	9 - 11	10.4	0.6
total GR (first arch)	16	28	10 - 17	13.1	2 6
total GR (last arch)	18	25	11 - 19	15	2.4

Table 2 Percent of HL and SL for *Arius midgleyi.*

Character	Holotype	Paratypes			
		n	range	mean	SD
Percent of HL					
head height	46	29	40-56	47.5	4.6
head width	67	29	56-76.5	66	3.9
eye l.	13	30	9-22	14	3.9
mouth gape	49	24	41-51	46.5	3.3
internostril dist.	35	24	29-39	33.5	3.3
snout l.	36.5	29	33-40	36	1.8
longest barbel l.	67	30	50-76	63	7.4
bony interorb. dist.	33	28	26-38	33	3.4
occip. process l.	32	30	25-35	30	2.4
occip. process w.	11	29	11-19	15	2.1
Percent of SL					
HL	32	29	29-34	31	1.3
head height	15	28	13-17	15	1.1
head width	21	28	18-24	21	1.5
eye l.	4	29	3-6	4	1.1
mouth gape	16	23	12-17	15	1.5
internostril dist.	11	23	9-12	10.5	1.3
snout l.	12	28	10-13	11	0.7
longest barbel l.	22	29	17-24	20	2.1
bony interorb. dist.	11	27	8-12	10	1.3
occip. process l.	10	29	8-11	9	0.7
predorsal l.	41	29	37-42.5	40	1.4
D. fin base l.	10	29	9-12	10	0.8
interdorsal space	26	28	23-29.5	26	1.6
adipose fin base l.	9	28	7-11	9.5	1.0
A. fin base l.	15	29	12-15.5	14	0.8
caud. peduncle depth	7	29	6-7	7	0.3
caud. peduncle l.	15	29	12-18	14.5	1.1
P. fin spine l.	19	25	13-19.5	17	1.6
D. fin spine l.	21	27	13-21	18	2.5

Body robust, rather compressed, tapered posteriorly (Figures 1, 2). Lateral head profile triangular and narrow. Predorsal profile straight, interorbital flat. Snout almost truncate, broad, projecting short distance beyond lower jaw in young; mouth subterminal in adults. Lips rubbery, thin at front of jaws and rather thick at corners; jaws strong, slightly elevated at symphysis – particularly the lower. Mouth broad, curved; band of teeth in upper jaw not or partly visible when mouth closed, though often just visible at sides of mouth. Nostrils ovate, placed well forward; anterior nostril directly before or slightly lateral to posterior one on which skin flap just conceals opening. Short crescentic groove on snout of small specimens. Eye rounded to almost oblong, orbit free from head skin; eye placed dorsolaterally and visible when head viewed from above; mid head length at or up to one eye diameter's distance, behind hind margin of eye; prominence of lateral ethmoid sometimes apparent in larger fish. Gill openings broad, membranes meeting at sharp angle well forward, margins broadly free of isthmus.

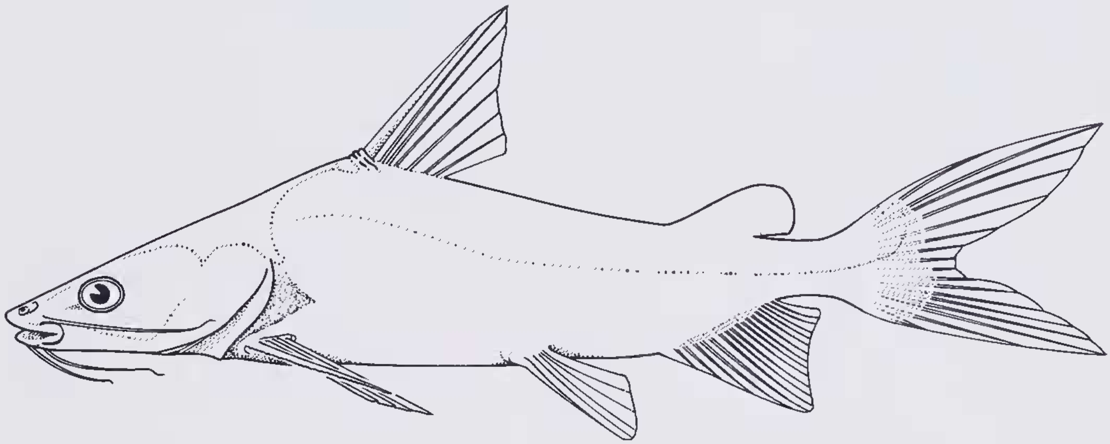

Figure 1 Drawing of the holotype of *Arius midgleyi* sp. nov., AMS I.20858-006. 270 mm SL.

Figure 2 *Arius midgleyi* paratype. WAM P.213380-001, 161 mm SL.

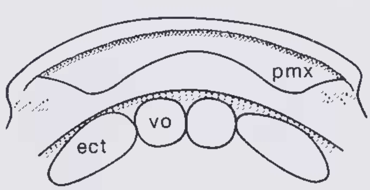

Figure 3 Semi-diagrammatic view of upper tooth pattern in *A. midgleyi* (ZMA 119.467), where pmx=premaxillary tooth band, vo=vomer tooth patches, ect='ectopterygoid' tooth patches.

Numerous small, sharp and depressible teeth arranged in band of irregular series in jaws, embedded in fleshy tissue: 16 to about 24 in upper jaw, 10-15 in lower jaw. Lower jaw band divided at symphysis by narrow edentulous space. Teeth present in four oval patches on palate (Figure 3), transversely arranged: patches always distinct and not contiguous, inner pair more rounded and about two-thirds width of outer pair; 8-12 series of teeth on smaller patches, 12-18 on larger. Palate smooth with sometimes a low, diagonal ridge of skin on each side posteriorly. Skin lining branchial chamber loose towards margin, and forming a deep pocket with narrow opening.

Head shield usually concealed by skin and mucus in juveniles and often in fresh, larger fish. When exposed, shield very granular, granules extending forward to above eye, to gill opening origin and over occipital process; predorsal plate rugose or granular. Dorsomedian head groove long and lanceolate, and distinct — beginning at level of nostrils and tapering posteriorly to or almost to base of occipital process, distal end bordered by loop of granular striae. Occipital process oblong and sometimes with low median keel, its sides straight. Head venulose over opercles. Numerous very fine papillae scattered over snout, anterior two-thirds of head and sometimes breast on many specimens. Triangular humeral process smooth to rugose, moderately ossified anteroventrally, its shaft oblique and acute, reaching two-thirds distance along pectoral spine. Axillary pore tiny, closely adjacent to process.

Barbels thin and tapered. Maxillary barbel reaching preopercular margin to almost head margin above pectoral base; mandibulary barbel reaching or falling well short of, ventral head margin; mental barbel extending to below middle or hind border of eye.

Gill rakers rigid, strong and rather sharp-tipped, as long as gill filaments. Rakers absent from posterior face of first and usually second arches; 11-17 (mean 15.2) rakers along rear of third arch. A low, thick pad of tissue usually present posterodorsally on second arch, other arches lacking such thickening.

Fin spines sharp, moderately to very thick, compressed. Fine longitudinal striae laterally on spines, outer (anterior) border roughened by granules and low dentae, few antrorse serrae near tip; inner (posterior) border of dorsal with no or few serrae extending half-way from apex; usually up to 20 saw-like, short serrae along inner border of pectoral spine. Tip of spines with short filaments. Dorsal spine longer than pectoral: longer than postorbital in young, about two-thirds in adults. Dorsal fin rather high, longest ray 2.7 (2-3.5, mean 2.9) times last ray. Pectoral fin reaching to below posterior dorsal rays. Adipose fin oblong and high, placed opposite middle of anal fin. Longest anal ray 3 (1.9-3.5, mean 3.1) times length of last ray; fin moderately elevated anteriorly, with concave outer margin. Caudal fin lobes long, broad basally, slender and tapered distally. Ventral fin moderately broad in females, reaching to anal fin origin or up to fourth anal ray, maturing fish with thick pads on fifth and sixth (inner) rays; in males and juveniles, fins narrow, never reaching and often falling quite short of, anal fin.

Lateral line sloping over anterior half of body, thence straight, slightly elevated on caudal fin base. Distinct vertical series of pores extending from line over back and lower sides; short oblique venules diverging along line's length, numerous and longer over 'shoulder'. Caudal peduncle moderately deep and compressed.

Colour when fresh: highly variable, perhaps relative to habitat and locality. Specimens from the Katherine River ochre-coloured, brownish above, creamy below; fins pale brownish orange, barbels pale. Ord and Roper River individuals countershaded olive brown, 'smokey' blue to dark blue above, white below a line from upper jaw along mid-sides to above anal fin or lower caudal peduncle; dorsal, adipose and caudal fins brown to dark bluish brown, pectoral and ventral fins dark (blue) above, cream below; anal fin brown or bluish brown, anterior and posterior of fin cream, sometimes only posterior rays dusky cream; maxillary barbel blue, others white. Some individuals with 'piebald' colouration have also been taken from Lake Argyle and Flora River: body greyish brown with small and large irregular cream or black blotches over anterior two-thirds of body – especially around mouth and on head. Peritoneum pale grey or pinkish. Fat bodies deep yellow or orange.

Colour when preserved: varies from brown above and fawn below to blackish or dark charcoal-blue above, fawn, orangey, cream or white below or blotched. Fins and barbels as above but blue becomes dark brown.

Distribution (Figure 4)

Common and widespread in rivers and associated fresh waters of north-western and northern Australia from the Fitzroy River through the Ord and Victoria River systems (including Armstrong, Camfield, Humbert, Wickham, East Baines, West Baines Rivers, Neave and Waterloo Creeks – Midgley 1981), the Keep River (rare) (Midgley 1981), Daly River, Katherine River, Flora, Fergusson, Fish and Douglas Rivers (Midgley 1980), McKinlay, Mary, South Alligator, East Alligator Rivers, Roper River system (Limmen Bight, Roper, Hodgson, Wilton and Mainoru Rivers – Midgley 1979, 1983), McArthur River, Tooganginie Creek (Midgley 1983), Robertson and Calvert River systems (Midgley 1982) (rare), south-easterly (rare) to the Flinders River (near Maxwelton), Gilbert, Staaten Rivers and Edward River system (Strathgorden Lagoon) on Cape York Peninsula (Midgley, pers. comm. 1986). (The record of distribution in the type series is supplemented here from specimens collected by H. and M. Midgley – the identification of a representative sample of which we have verified – and from additional material [non-type] we have determined and list herein.)

The four additional ariid species are distributed in northern Austalia as follows: *Arius graeffei* is sympatric with *A. midgleyi* throughout the range of the latter; *C. froggatti* is restricted to the Roper River drainage; *A. berneyi* extends throughout Queensland, but no further west than the Roper River system; and *A. leptaspis* extends from northern Queensland (west or north-draining rivers) just into the western Northern Territory.

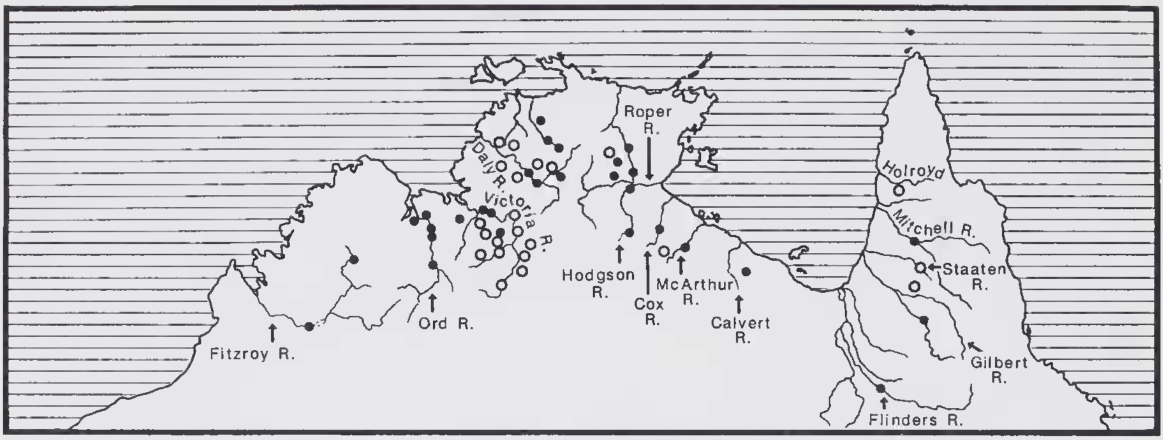

Figure 4 Australia north of 22°S, showing the distribution of *Arius midgley;* ● represents material determined by us; ○ represents additional records by H. and M. Midgley.

Etymology

This large catfish is given the surname of Hamar and Mary Midgley who first brought its existence as a distinct taxon to the attention of the first author and in part recognition of their enthusiastic and dedicated study of the fresh waters of northern Australia.

Habitat notes

Fresh water, only a few records from water near the upper limit of tidal influence. Found in fast-flowing main rivers, billabongs, creeks, deep pools and drying-out waterholes. Water conditions vary considerably from turbid (10 cm visibility) to very clear (4 m visibility), still or moderately-fast flowing. The water is alkaline (ph 7-8.7) and warm (surface temperature 22.5-35°C) (Allen 1982; Midgley 1979-83). *A. midgleyi* is possibly replaced in downstream reaches by one or both of the other common ariids in northern Australia: *A. leptaspis* and *A. graeffei.* For example, Bishop *et al.* (1986) caught no *A. midgleyi* during their extensive survey of the Jabiru-Alligator Rivers area; and neither did Midgley (1984). Although *A. leptaspis* is absent from Lake Argyle, *A. graeffei* makes up about 30 per cent of the fork-tailed catfish population in the impoundment.

Biological notes

In establishing the validity of *A. midgleyi* as a taxon, we collected information on the species' biology which further characterises it as distinct from sympatric ariids. Independent observations, together with our own, substantiate the unbiased nature of our conclusions.

Maximum size: to about 28 kg (S. Sharpe, pers comm. 1987); to approximately 1.3 m TL (R.J. McKay, pers. comm. 1978; S. Sharpe, pers. comm.).

Diet: primarily predatory, but becoming a facultative omnivore during the dry season. Recorded gut contents are fish (notably the bony bream, *Nematalosa erebi* (Günther, 1868), in Lake Argyle (N. Morrissy, pers. comm.), aquatic and terrestrial insects and insect larvae, beetles and crustacean fragments (probably *Macrobrachium* sp.). Such items were present in the stomachs of specimens prepared for osteological study by one of us (PJK). The size of food items was large in large fish. In a study conducted between August and September, Midgley (1981) recorded prawns, aquatic beetles, terrestrial beetles and grasshoppers in the stomachs of *A. midgleyi* specimens.

Breeding: *A. midgleyi* breeds only in fresh water with no recorded spawning migrations. Midgley (1979; pers. comm. 1986) has caught juveniles as small as 63 mm SL from riverine situations (e.g. upper reaches of the Flinders River) in company of larger adult fish. We have not examined fully mature fish, and little information is available, probably because surveys have often been conducted during the late dry season. Specimens captured in August from the Roper River area are in the early stages of maturation suggesting that *A. midgleyi* conforms to the general early wet season spawning pattern of *A. graeffei* and other ariids (Rimmer 1985). In the Victoria and Daly rivers areas, individuals at gonadal maturity stages III or early IV (*sensu* Snyder 1983) were obtained during September and October and were more mature than the sympatric *A. graeffei* population (Midgley, pers. comm.). Lake Argyle individuals captured during September are in maturity stage V (S. Sharpe, pers. comm.). From 35 fish netted in Lake Argyle at the end of July 1980, N. Morrissy (pers. comm.) determined 20 to be maturing females, stages II to IV. The remaining 15, of the same size range, were either immature or non-ripening fish (both sexes). Morrissy noted difficulty in ascertaining the sexes of immature and 'resting' fish, a problem recognised by K. Bishop (pers. comm.) and Rimmer (1985). In Morrissy's sample of 20 mature fish, 13 had ova of 1 cm diameter (52 to 87 cm FL), five had ova of 0.5 cm diameter (58 to 76 cm FL) and two had ova of less than 0.2 cm diameter (53 to 57 cm FL).

Morrissy (pers. comm.) noted that females between 70 and 80 cm FL have about 100 ova in each gonad. K. Lightburn and B. Host (pers. comm. 1980) counted up to 180 ova (total) in mature females from Lake Argyle, and S. Sharpe (pers. comm. 1987) estimated a single spawning fecundity of 100 to 400 ova over the size range of mature fish. None of our informants ascertained whether the count differed between gonads.

Subsequent work on *A. midgleyi* in Lake Argyle (N. Morrissy, pers. comm.) employed length frequency analysis to determine that females matured at the beginning of their third year of life at approximately 50 cm FL.

Growth and behaviour: in Lake Argyle, where the population has been fished commercially since 1978 (Morrissy 1983), *A. midgleyi* has been observed moving in large schools of similar size individuals. The brooding males congregate in

Figure 5 Comparison of head shape of *A. midgleyi* (RHS, holotype) and *A. leptaspis* (LHS, QM unreg., Gulf of Papua, 235 mm SL) when viewed from above (preserved specimens).

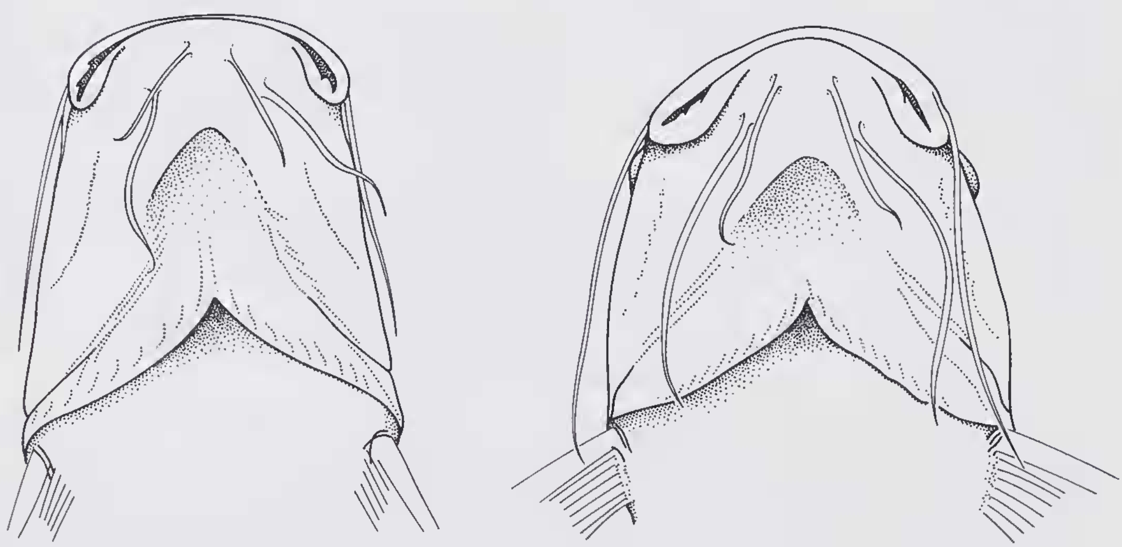

Figure 6 Comparison of head shape of *A. midgleyi* (LHS, NTM S.11153-001, Mainoru R., NT, 110 mm HL) and *A. leptaspis* (RHS, NTM S.11153-002, same locality, 113 mm HL) when viewed from below (preserved specimens).

deeper water in a manner comparable to that reported by Aldaba (1931) an Mane (1929) of Laguna de Bay (Philippines) ariid catfishes.

A length-frequency study on 650 individuals was conducted by N. Morriss in Lake Argyle, between 30 July and 7 August 1980. The fish were gill nette (2.5-18 cm mesh) in about 10 m depth. Morrissy caught only three fish less thai 20 cm FL – (probably the 0+ year class*), most fish were 25 to 50 cm FL witł a total body weight to 2 kg (presumably the 1+ year class), and the remaindeı between 55 and 75 cm FL (presumably the 2+ year class). S. Sharpe, a Lake Argyle commercial fisherman, informed us (1987) that *A. midgleyi* juveniles attain a length of 20 to 30 cm within their first year. *A. midgleyi* in either case, exhibits a very rapid growth rate under these conditions relative to other northern Australian ariids. It is faster growing than *A. graeffei* in this reservoir and indeed, is the largest truly freshwater fork-tailed catfish in Australia. *A. midgleyi* is favoured by conditions in this impoundment, as it is seldom numerically dominant elsewhere in its range.

Remarks

A. midgleyi is immediately recognisable in the field because of its rather oblong, 'square' snout (Figures 5, 6) and broad mouth (approximately equal to the outside distance between the eyes – Midgley 1981). Dubbed 'squarenose' or 'shovelnose' by fishermen, it looks somewhat shark-like underwater.

At our request, Janet Gomon (USNM) examined some of Taylor's (1964) specimens of '*A. leptaspis*' from northern Australia. Based on our diagnoses, she believes that Taylor's specimen from near the Roper River Mission (USNM 173564) belongs instead to *A. midgleyi.*

Allen and Hoese (1980) considered that 10, possibly 13 fish species present in the eastern and western extremities of the Gulf of Carpentaria drainage system exhibit disjunct distribution patterns, and in view of its rare occurrence in the southern Gulf of Carpentaria drainage, *A. midgleyi* appears to fall into this category. We believe that such a phenomenon may equally be an artefact of collecting effort. In view of studies conducted in aquaria by one of us (BEP) on four of the species cited (individuals maintained at 16-20°C over winter, two species breeding at 20°C), it is our opinion that temperature may not be the sole cause of the apparent disjunct distribution.

Allen and Hoese (1980) conjectured that a disjunct distribution pattern may be caused by lower winter water temperatures in streams flowing into the southern Gulf of Carpentaria: here the temperatures decrease to 22-23°C during winter, compared to 27-32°C in northern streams (Allen and Hoese 1980). Extrapolating from Nix and Kalma (1972) (who postulated a lowering of 5-6°C in water temperature during the Pleistocene), these authors reasoned that minimum water

* (Supported by the similar sized specimens from AMNH 51649 which were eviscerated prior to clearing: SL's 103, 106, 114, they had abundant yolky-coloured fat in the body cavity and were captured early May: probably 0+ juveniles.)

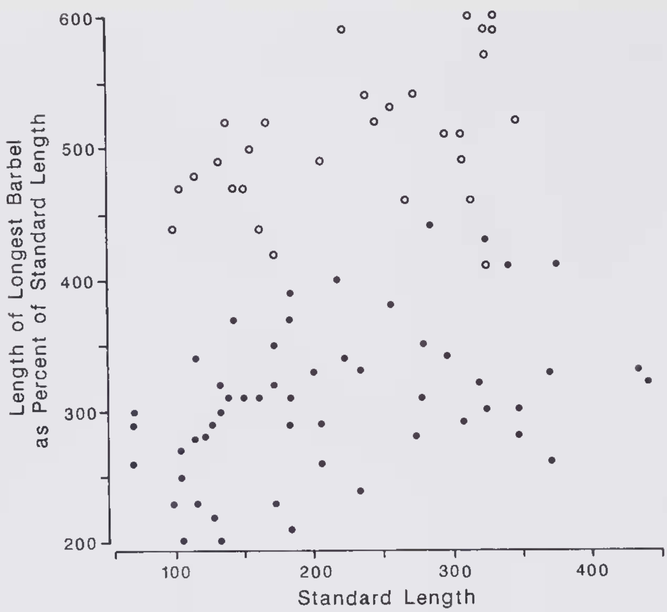

Figure 7 Comparison of longest barbel length between *A. midgleyi* (○) and *A. leptaspis* (●) expressed as per cent of SL.

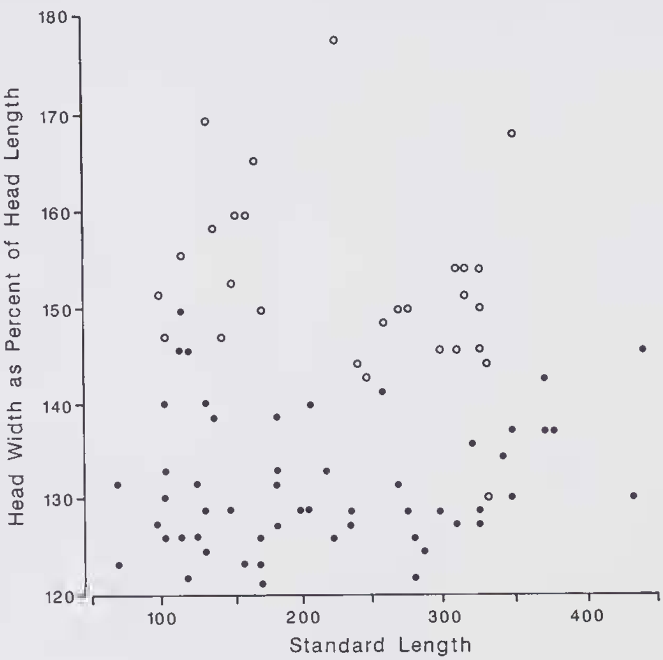

Figure 8 Comparison of head width between *A. midgleyi* (○) and *A. leptaspis* (●) expressed as per cent of SL.

temperatures to at least 18-19°C in the lower Gulf would have proved an effective barrier during that period to the southerly dispersal of some extant fishes. However, if temperature were the key factor involved, it begs the question of why isn't *A. midgleyi* known from southern New Guinea? From our understanding of Nix and Kalma (1972) and associated papers, we believe that changes in other abiotic conditions (for example, geomorphology, aridity, seasonality, water salinity and river flow) besides temperature, have likely contributed to the present-day distribution pattern of northern Australian freshwater fishes.

Additional non-type material examined

Western Australia

Unregistered, (13), Lake Argyle, 1980, 170-385 mm SL; AMS I.16838-006, (2), Ord River, 1971, 137 & 151 mm SL.

Northern Territory

NTM S.12077-001, (1), Roper River, 1979, 107.5 mm HL (cleared and stained); QM I. 16743, (1), Wilton River, 1979, upper jaw only, SL not stated; QM I.16744, (1), I.16745, Mainoru River, 1979, upper jaw only, SL not stated; QM I.16745, (1), same data, upper jaw only, SL not stated; NTM S.11153-001, (1), Mainoru River, 1979, 110 mm HL; AMNH 51650, (1), Katherine River, 8 mi. downstream from Katherine, 1969, 125 mm SL; NTM S.12087-001, (3), Katherine River near Limestone Creek junction, 1980, 355-385 mm SL (111.6, 120.5, 117.2 mm HL); AMS I.16838-007, (3), same data, 127-151 mm SL; AMS I.20924-008, (1), Mary River, 1978, 310 mm SL; AMNH 51649, (2), junction of Big Horse Creek and Victoria River, 1969, 104 & 122 mm SL; AMS I.20858-005, (8), Wickham Gorge, Victoria River, 1978, 255-320 mm SL; AMS I.20848-010, (1), Jasper Gorge, Victoria River, 1978, 87 mm SL; AMS I.20856-004, (2), Bullo River (Victoria River drainage), 1978, 212 & 225 mm SL; AMS I.20847-008, (1), upstream from Daly River crossing, 1978, 240 mm SL; AMS I.20857-002, (1), Victoria River district, 1978, 240 mm SL; AMS I.20453-001, (1), McKinlay River, 1978, 250 mm SL; AMNH 51651, (16), South Alligator River on Pine Creek-Oenpelli road crossing, 1969, 118-224 mm SL; AMNH 51650, (1), Katherine River, 8 miles downstream from Katherine, 1969, 125 mm SL. QM I.16744, (2), Mainoru River, 1979, upper jaws only, SL not stated; QM I.16745, (2), same data, upper jaws only, SL not stated; QM I.16743, (1), Hodgson River, 1979, upper jaw only, SL not stated.

Queensland

QM I.16741, (2), McArthur River, 1975, 123.5 & 130.7 mm HL.

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